

# HYTRAS

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ASC PI Meeting  
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**Modeling transport of radionuclides and  
chemicals in rivers and estuaries**

# Problem statement

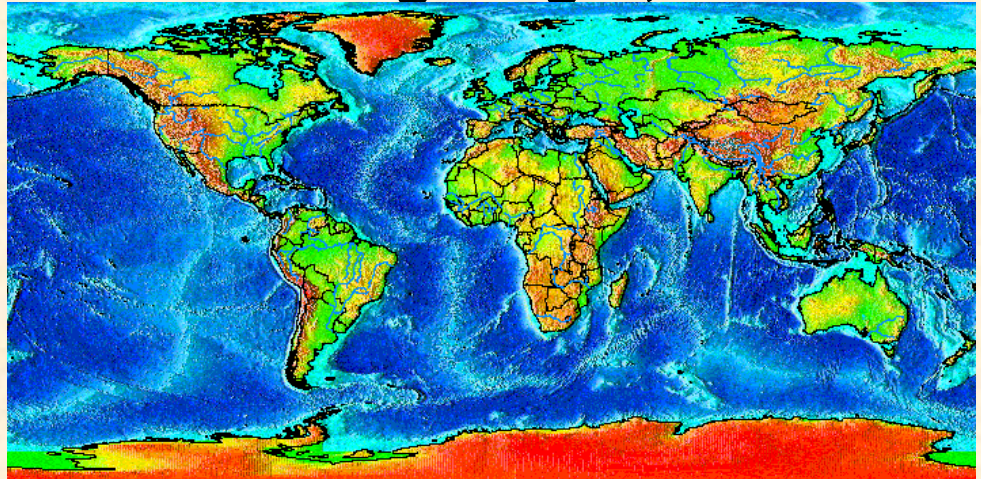
- **Interdiction strategy at ports**
- **Consequence management (CM)**
- **Realistic training**

# Models

- **Fast model for scenario analysis (SA) and training**
  - Minutes on a laptop
- **Intermediate model for SA**
  - Minutes on a mid-sized HPC machine
- **High fidelity model - validation and guidance**
  - Hours to days on MHC machine
  - Used for real situation (forensic, CM, etc.)

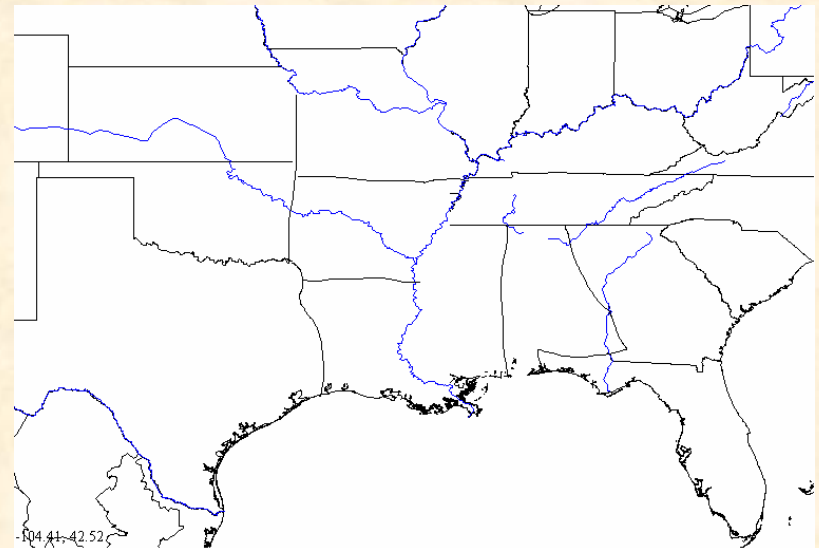
# HYTRAS - Existing model

- **Fast running - for rivers only**
- **Developed for DTRA to be used with HPAC**
- **Simple model for Radiological/Chemical/Biological materials**
- **World wide db - 200 rivers including length, width and depth.**



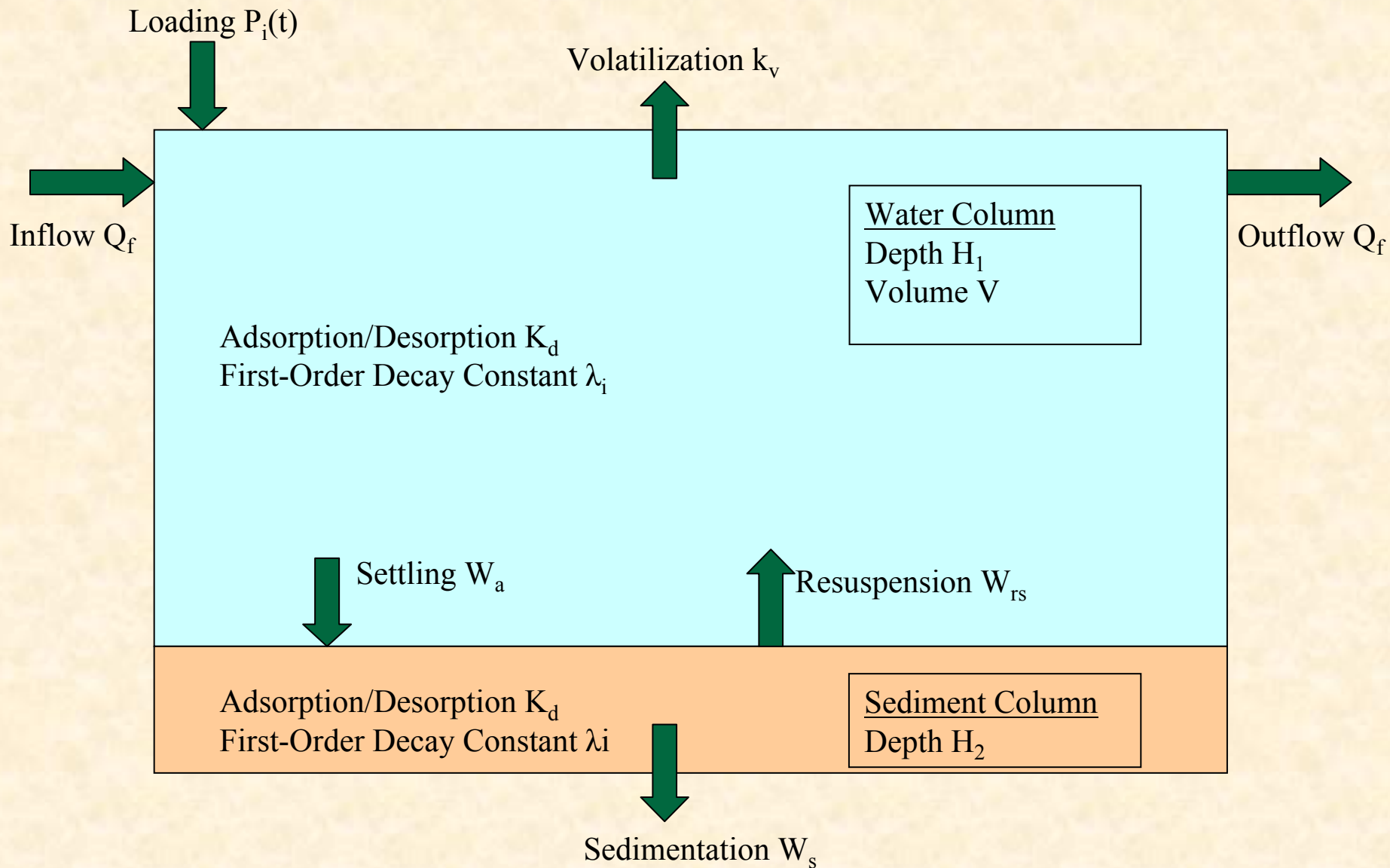
# FY03 work

- **Extend HYTAS to model estuaries**
  - Support Interdiction analysis
  - Model accurate for some bays/estuaries
  - Working with U. of Fla.
- **Began development high fidelity model**
  - Survey existing models
  - Survey existing data for river/estuaries



# HYTRAS

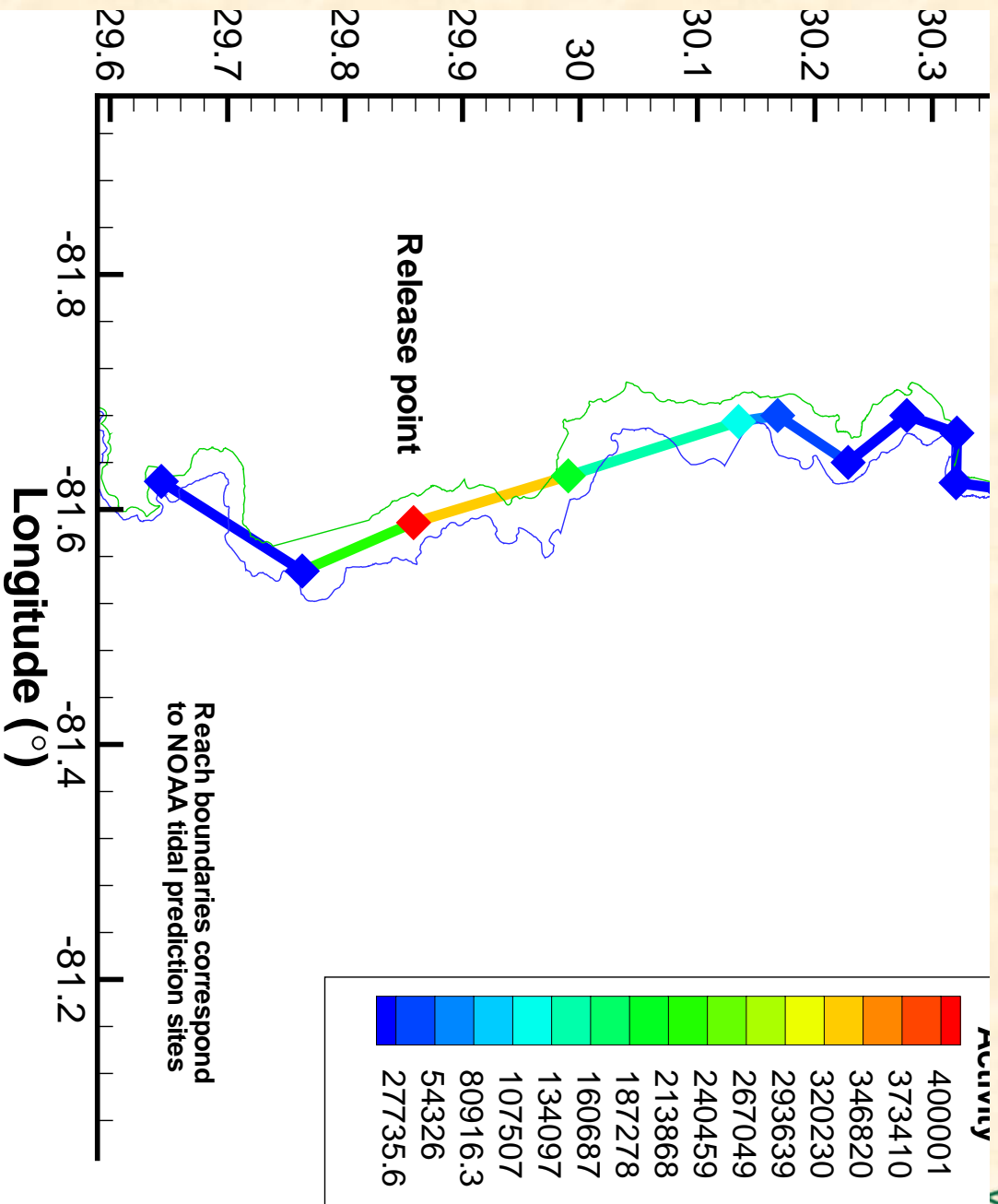
- **Original version used compartment model for transport and fate of a contaminant in rivers.**
- **Many contaminant-specific processes included (see next slide).**
  - Between water and sediment
  - Between water and air
- **Models either chemicals or radionuclides**
- **Models a single channel, not tributaries - conservative assumption for concentration.**



# Estuary/bay model

- **Reversal of flow (i.e., tidal flow) added to HYTRAS 1D compartment model.**
- **Linkage to existing 1-D estuary/bay model underway (University of Florida)**
- **St. John's River system (Jacksonville/Mayport Naval Base) used for development**

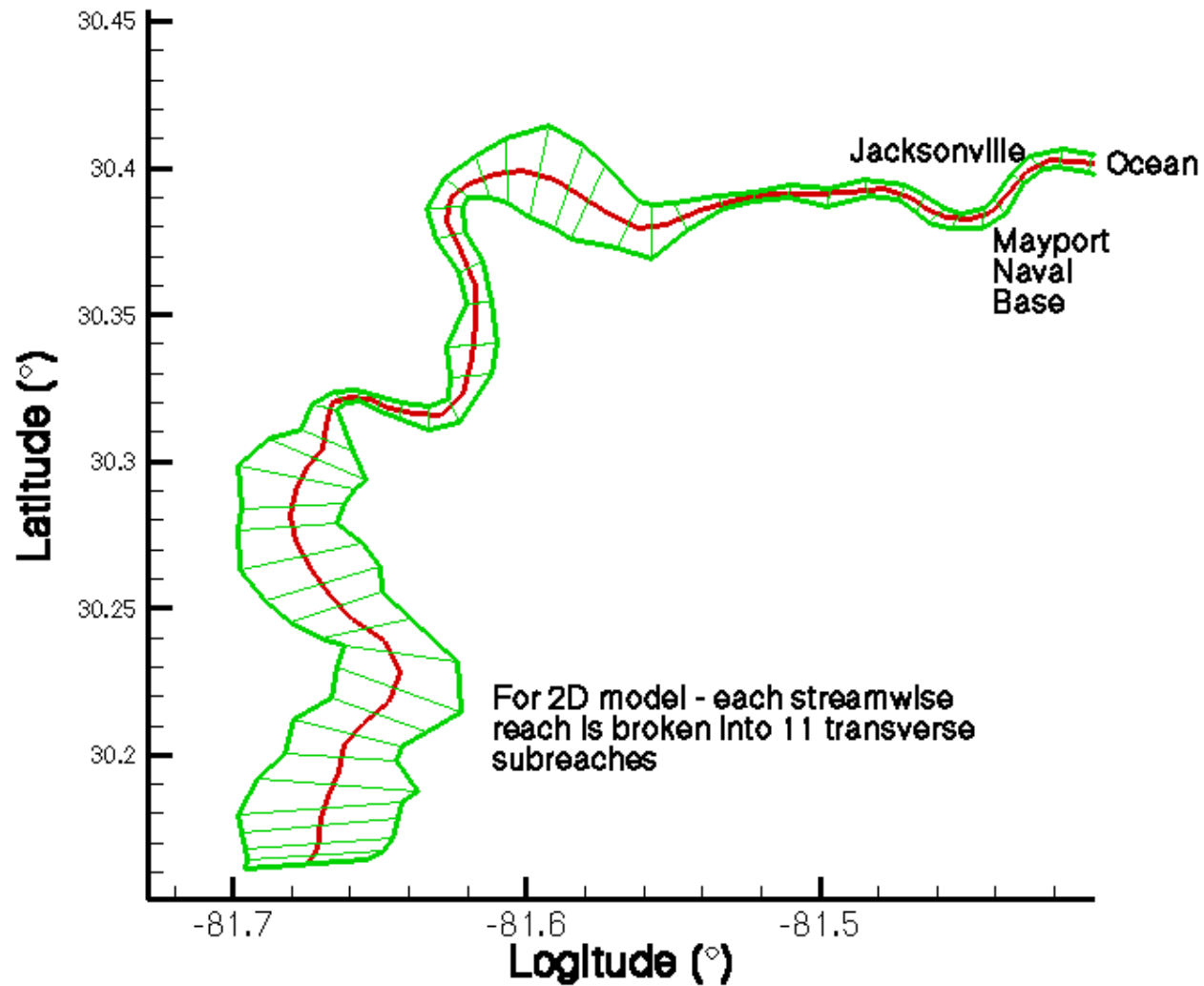




# Current work

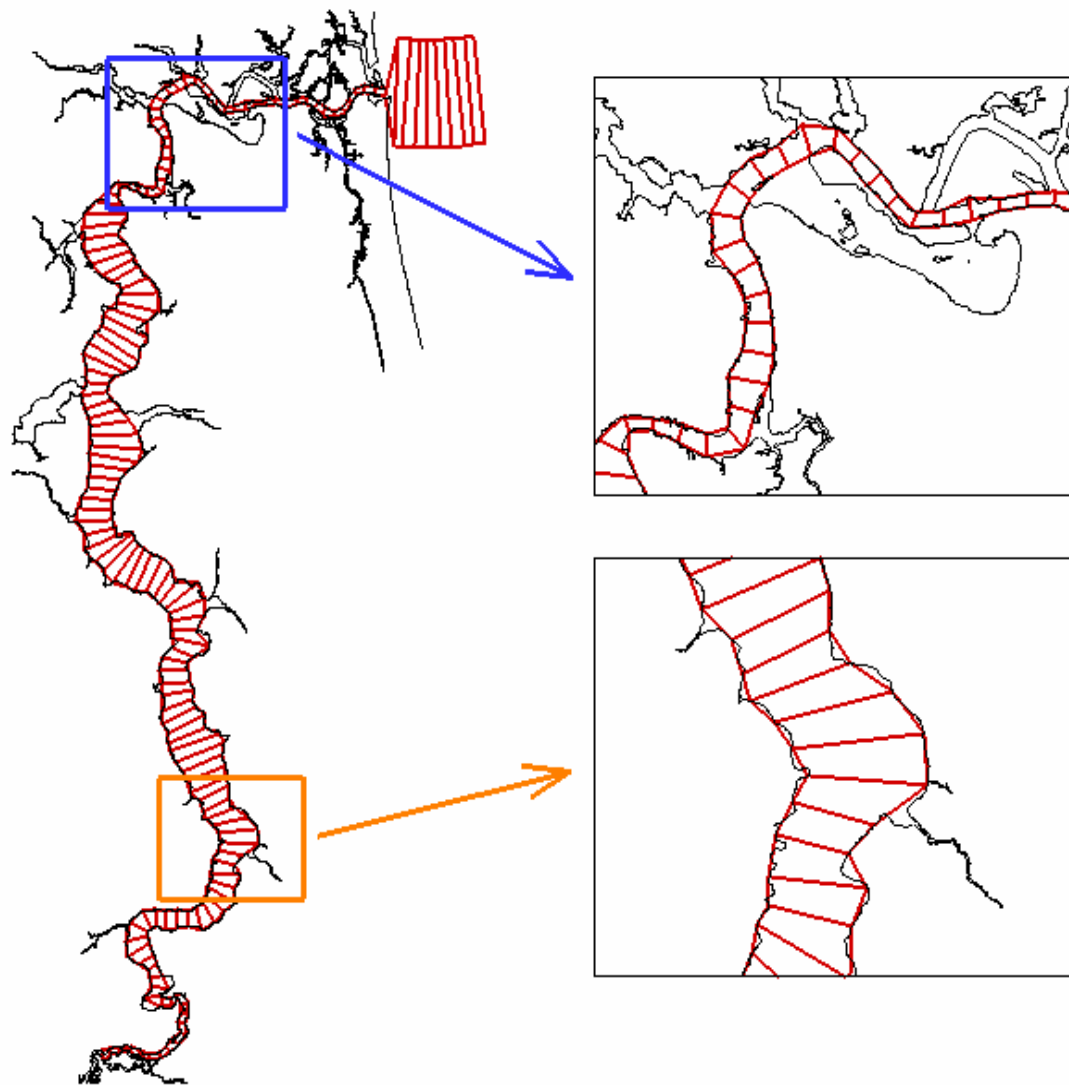
- **A prototype 2D compartment model has been developed.**
- **Uses flow data extrapolated from NOAA predictions.**
- **With only a single chemical, this model takes too long for a “First Responder” type of calculation.**

# HYTRAS 1D and 2D model of the Lower St John's River



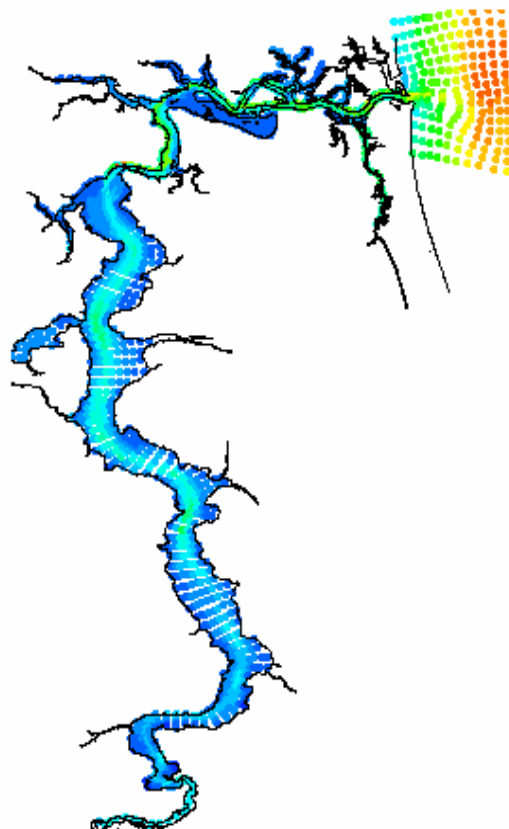
# Dr. Peter Sheng's 1D code

- **Dr. Sheng has developed a 1D code which calculates the movement of water through the estuary**
- **Driven by predicted tidal results and wind**
- **Can transport several species but HYTRAS Radionuclide model not yet incorporated**

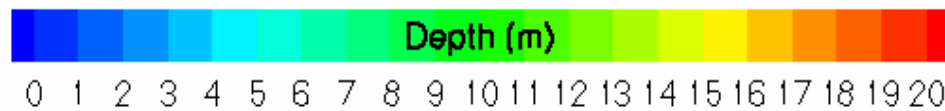
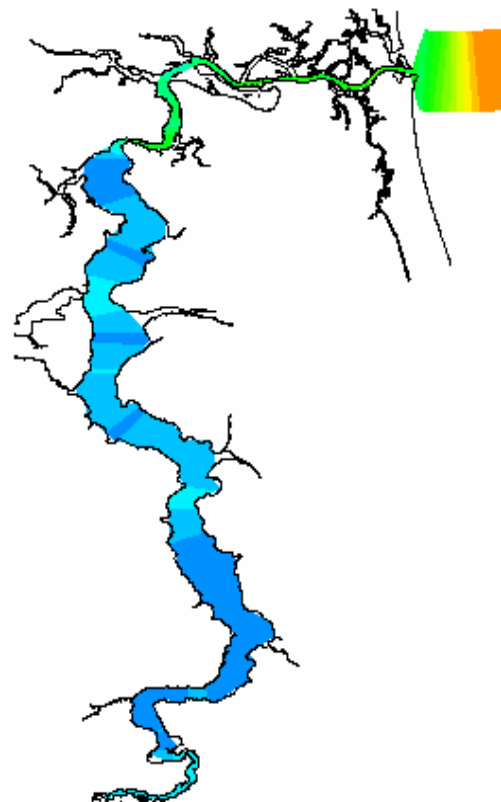


$\Delta s = 1000$  m (152 Grid Cells)

Data Points



1-D Grid



# Current movie

QuickTime™ and a BMP decompressor are needed to see this picture.

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# Computation resources required grows with complexity of model

Model	Reaches	CPU time/day
<b>HYTRAS 1D</b> 1 chemical	5	0.6 s
<b>HYTRAS 1D</b> 28 daughters	5	60 s
<b>HYTRAS 1D SJR</b> 1 chemical	19	5 min* Dt=1s
<b>U of Fla 1D, 1 Species</b> SJR flow model	152	0.27 s
<b>HYTRAS 2D</b> SJR 1 chemical	60 x 11	8 hours*

# Numerical methods

- **HYTRAS uses an explicit technique**
  - Adequate for 1D - uni-flow cases
  - Courant stability limitation requires excessive cpu time for estuary and 2D
  - Implicit technique needed
    - Requires special techniques for parallel
- **Sheng uses more efficient technique**
  - Radionuclide calculations require matrix manipulation every time step
    - Will significantly increase cpu time requirement for HYTRAS/Sheng

# More work to do

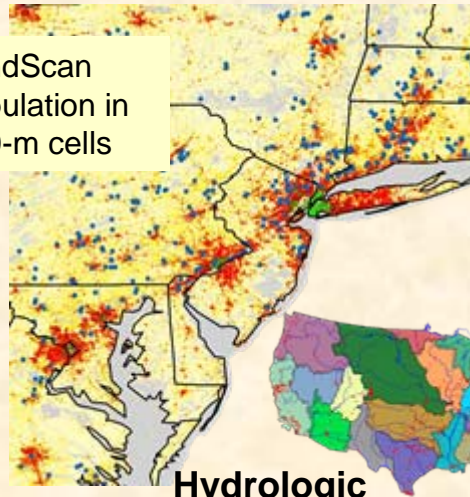
- **Resulting model will be ported to a parallel computer**
- **Future work will add:**
  - **2-D, then 3-D estuary/bay models**
  - **Link to population database**
  - **Ocean model**

# Protecting the Nation's Water Supply: Hydrologic Transport Assessment System (HYTRAS)

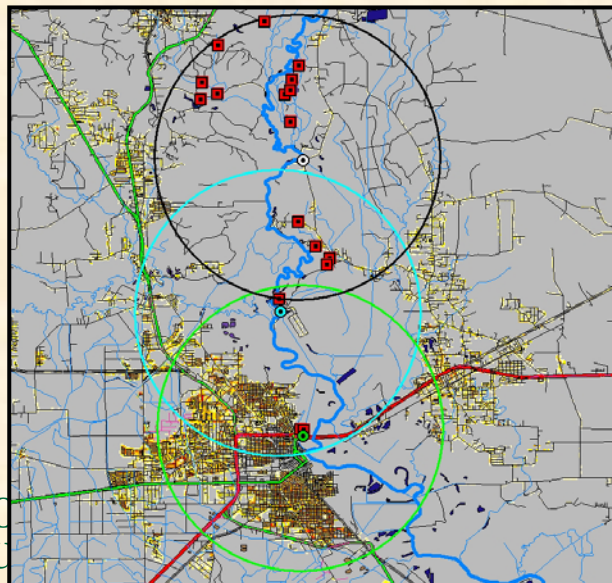
**HYTRAS predicts the transport of nuclear, biological, and chemical agents in surface waters**

LandScan  
population in  
500-m cells

**Drinking water intakes  
serving more than 10,000  
people**



**Hydrologic  
regions**



**HYTRAS uses  
geospatial  
information  
hydrological data,  
and soil and sediment  
characteristics to  
estimate nuclear,  
biological, and  
chemical agent  
concentrations in  
water and sediment**

**HYTRAS includes an  
Estuary/Bay Model**

